Determinants of E-Business Use in U.S. Firms

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ABSTRACT: The factors leading to variations in e-business use among U.S. firms are identified. Building on diffusion of innovation theory, an integrated model is developed that explains the relative influence of eight known determinants. Diversity and volume of e-business use are empirically investigated using a sample of 294 firms. The analysis demonstrates that (1) considering the diversity of e-business use, pressure from trading partners is the most important driver, (2) when e-business volume is investigated, government pressure emerges as the strongest factor, (3) government promotion may not have much effect on the diversity of e-business use by private companies, but does significantly influence the volume of e-business use by firms doing business with the government, and (4) the United States has a positive regulatory environment for supporting e-business. Taken together, these findings on the multidimensionality of e-business use show that diversity and volume are not only different measures of e-business use, but also have different determinants. The integrated model provides a more comprehensive explanation of e-business use and could serve as a foundation for future research on interorganizational systems.

KEY WORDS AND PHRASES: E-business, innovation, innovation diffusion, innovation implementation.

E-business—the use of Internet-based computing and communications to execute both front-end and back-end business processes—is being increasingly implemented by firms [45]. Companies using e-business realize dramatic returns through efficiency improvements, inventory reduction, sales increase, customer relationship enhancement, new market penetration, and ultimately financial returns [2, 3, 44, 45, 77, 78].

Nevertheless, firms vary considerably in their use of e-business. Many pure dot.coms only use the Internet to provide front-end services to customers, such as product information, on-line ordering, and post-sales services, whereas quite a few click-and-mortar companies treat the Internet not only as an additional channel for sales but also as a key to improve supply-chain management. The Internet is integrated into entire business processes—from product design, procurement, production, distribution, inventory control, to pre- and post-sales services [45]. Zhu and Kraemer's study indicates that high-tech manufacturing companies are leaders of e-business use in terms of four e-business capability metrics (on-line product information, on-line transaction, on-line interaction and customization, and supplier connection) in comparison to non-high-tech manufacturing firms [78].

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Even within the same industry, firms use e-business differently. For example, in the computer industry, Dell is a leader in using the Internet to extend the reach and scope of its direct sales business model [38]. In 1999, Dell was already resolving 80 percent of technical support issues over the Internet, higher than the industry average of 27 percent [12]. In 2002, Dell sold 48 percent of its computers via the Internet, while the nearest competitor sold only 20 percent [11]. Today Dell not only sells on-line but also purchases components and exchanges real-time data, such as inventory level, with its business partners via a proprietary procurement system, ValueChain.dell.com [47]. Why other companies do not make as much use of the Internet for sales and services is unclear. Some research indicates that it may be due to technological backwardness, organizational obstacles, environment constraints, or other factors. The purpose of this paper is to identify the factors that explain the variation in e-business use among U.S. firms.

In order to fully understand e-business use, it is necessary to borrow from innovation diffusion theory, which tries to explain how innovations are adopted and used in organizations. Rogers [65], Tornatzky and Fleischer [72], and Iacovou, Benbasat, and Dexter [31] have all proposed solid models of organizational innovativeness. None of these three models specifically focuses on e-business use, which is new and has different features than many previous IT innovations, but each of them contributes useful insights that are here combined into a single theoretical framework for studying e-business use.

Many studies use innovation diffusion theory to examine the adoption stage, the first step in innovation diffusion [7, 8, 41, 56, 60, 71, 79], but there has been significantly less research on innovation use, the stage after adoption. Tornatzky and Klein argue that innovation research should focus on both adoption and use as dependent variables, and not simply dichotomous yes/no adoption decisions [73]. The present research focuses on e-business use rather than e-business adoption. In particular, it examines two dimensions of e-business use—diversity and volume.

Literature Review

Theoretical Foundation

Diffusion of innovation theory (DOI) is a fundamental approach to investigations of how a new technology diffuses [65]. Concerned with the manner in which a new technological idea, artifact, or technique migrates from creation to use, DOI describes the patterns of adoption, explains the mechanism of diffusion, and assists in predicting whether and how a new invention will be successful. Rogers's diffusion of innovation theory posits that a firm's adoption and use of innovations is influenced by innovation characteristics and organizational characteristics. Factors in the innovation characteristics category are the "perceived attributes of the innovation" that either encourage innovation use (e.g., relative advantage) or inhibit it (e.g., complexity). Rogers indicated that five attributes of an innovation (relative advantage, compatibility, complexity, trialability, and observability) can explain 49–87 percent of the

variance in rate of adoption. While the innovation characteristics explain a portion of the innovation diffusion, these results are primarily based on studies at the individual decision-making level [8]. When considering the diffusion of an innovation used at the organizational level, Rogers reported that several organizational characteristics influence the adoption and use of innovations. Chief among these were centralization, size, slack, formalization, and interconnectedness. Rogers's diffusion of innovation framework is shown on the left side of Figure 1.

Although Rogers's diffusion of innovation theory seems to be quite applicable to an investigation of innovation use [58], researchers continue to search other contexts influencing organizational innovativeness and combine them with Rogers's theory to provide richer and potentially more explanatory models [57]. Tornatzky and Fleisher use a framework similar to Rogers's framework but comprising three categories—technology, organization, and environment (TOE)—to explain a firm's technological innovation decision-making behavior [72]. Their technology and organization categories are parallel to the two categories in Rogers's model, but their framework also includes a new and important component, environmental context. The environment context is the arena in which a firm conducts its business—its industry, competitors, and dealings with government. The environment presents both constraints and opportunities for technological innovation. The TOE framework makes Rogers's innovation diffusion theory better able to explain within-a-firm innovation diffusion, as can be seen in the middle of Figure 1.

Over time, however, innovations become more complicated and are used beyond the boundaries of any single firm. More and more interorganizational systems (IOSs) turn out to be significant in the business world. For example, electronic data interchange (EDI) and B2B e-commerce are innovations that involve integration between multiple businesses. The two frameworks discussed so far may not capture some IOS characteristics that influence firms' use of IT innovations. To further understand IOS adoption and use, Iacovou, Benbasat, and Dexter analyzed seven case studies to illustrate EDI adoption, implementation behavior, and EDI impact in small firms [31]. Their framework is well suited to explain the innovation diffusion process of an IOS. The category of perceived benefits in their framework can be viewed as the technology context in the previous models, while organization readiness is similar to the organization context. Most importantly, since EDI is a network interorganizational system in which pressure from trading partners plays a critical role in EDI adoption and use, the Iacovou, Benbasat, and Dexter model included and highlighted external pressure as an important factor. However, more general environmental factors were not included in their framework, which is depicted on the right-hand side of Figure 1.

The present research combines features of all three previous models to derive an integrated framework for e-business use. The research model proposed here comprises four constructs. The first two, technology (perceived benefits) and organization readiness, are consistently used in all three frameworks in the literature. The third is an environment construct that contains neutral environment characteristics from the Tornatzky and Fleischer framework. Finally, since e-business contains both B2C and B2B transactions over the Internet

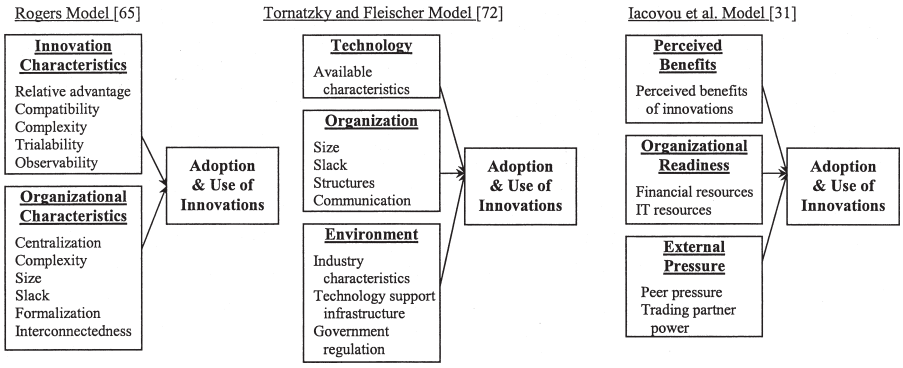


Figure 1. Previous Innovation Adoption and Use Models

with B2B as an IOS innovation and the successor of EDI, the model also includes external pressure as highlighted in the Iacovou, Benbasat, and Dexter framework.

Review of Research in Innovation Use

The three frameworks in innovation diffusion theory have been examined in a number of empirical studies. Most of the empirical research, however, is concentrated on the adoption stage, and significantly less attention has been paid to the use stage, which occurs after the adoption decision is made. Table 1 presents a summary of major studies focusing on innovation use, a subject closely related to the research object of this paper—e-business use.[1]

Many of the studies summarized in the table investigated the use of within-a-firm IS innovations: MRP, software, Web technology, knowledge platform, and EIS [6, 9, 18, 59, 60]. A few others investigated between-firm (IOS) innovation, including EDI and customer-based IOS, which is more related to the topic of this paper and thus informed the research presented here [22, 27, 51, 55, 69]. However, none of the studies in Table 1 specifically investigated e-business use, an important phenomenon in the business world that in many respects differs from earlier IT innovation. Finding out whether diffusion of innovation theory can be applied to e-business and what factors explain the variations in e-business use are well worth investigating.

Second, although most of the existing empirical research employed diffusion of innovation theory, the factors suggested by DOI were examined separately in different models. The first six studies in Table 1 only focus on factors in one context in DOI theory (either technology, organizational, or external pressure). The other five studies examine factors in two contexts. The fact that all of these studies examined only one or two sets of factors and excluded some relevant variables may have affected their interpretation of the results or led to overestimates of the impact of some factors [8, 25]. This was a strong motivation for developing a unifying framework that includes important factors from several theoretical perspectives in DOI in an effort to understand

Number	Authors	Theory	Dependent variables	Independent variables
1	Cooper and Zmud [9]	Diffusion of innovation theory	Material requirements planning (MRP) infusion (four infusion stages defined)	**Technology** Task and technology compatibility, Task and technology complexity
2	Permkumar, Ramamurthy, and Nilakanta [55]	Diffusion of innovation theory	Extent of EDI adaptation Extent of EDI internal diffusion Extent of EDI external diffusion EDI implementation success	**Technology** *Compatibility, *relative advantage, *costs, *duration, complexity, communicability
3	Fichman and Kemerer [18]	Diffusion of innovation theory	Assimilation stage of software (six assimilation stages defined)	**Organization** *Learning-related scale, *staff's knowledge, *diversity of organizational knowledge Control variables *Size, specialization, education, complexity, sector
4	Chatterjee, Grewal, and Sambamurthy [6]	Institutional theory	Web assimilation (scale from 0 to 9)	**Organization** *Top management championship, *strategic investment rationale, *extent of coordination, organization age, industry, Web experience
5	McGowan and Madey [51]	Diffusion of innovation theory	EDI volume EDI diversity EDI depth	**Organization** *Size, *functional differentiation, *training availability, *EDI knowledge, centralization, technical expertise
6	Hart and Saunders [27]	Diffusion of innovation theory	EDI diversity EDI volume	**External pressure** *Customer power, *supplier trust

(continues)

Table 1. Empirical Literature Related to Innovation Use.

Table 1. (continued)

Number	Authors	Theory	Dependent variables	Independent variables
7	Son, Narasimhan, and Riggins [69]	Transaction cost theory, social exchange theory	EDI volume EDI diversity	**Transaction channel climate** *Asset, *trust, *uncertainty, *cooperation **External pressure** *Power, *reciprocal investments Control *Relative advantage, IT infrastructure, *transaction volume, *year
8	Purvis, Sambamurthy, and Zmud [59]	Diffusion of innovation theory, institutional theory	CASE volume: % of the projects that use CASE (CASE technology is a knowledge platform used in organizations)	**Technology** *Project size, time since adoption **Organization** *Current methodology use, *prior methodology use, *methodology compatibility, *knowledge embeddedness, size
9	Grover and Teng [22]	Diffusion of innovation theory	Customer-based interorganizational systems (CIOS) volume: % of an organization's sales handled through CIOS, and % of customers with access to the CIOS	**Technology** Compatibility, relative advantage, complexity **Organization** *Training, *customer participation, promotion, championship, top management support
10	Ranganathan, Dhaliwal, and Teo [61]	Diffusion of innovation theory	Web technology assimilation and diffusion (scale from 1 to 7)	**Organization** *Managerial IT knowledge, *Centralization, *Formalization **Environment** *Supplier interdependence, *IT activity intensity, competitive intensity
11	Rai and Bajwa [60]	Diffusion of innovation theory	Executive Information Systems (EIS) use level (sum of indicated proportion of executives for whom EIS applications had been developed and installed)	**Organization** *Top management support, *IS support **Environment** *Environment uncertainty

*Significant factors.

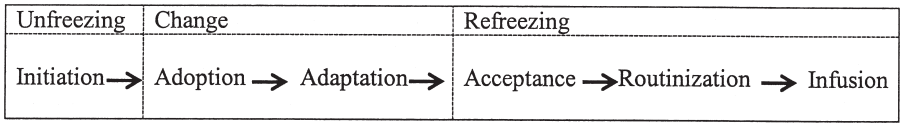


Figure 2. Kwon and Zmud's [43] Six-Phase View of the IT Use Process

their relative influence on e-business use. As Khun observes, having a unifying framework can contribute to cumulating the efforts within the research area of interest and lead to the development of better theories that exhibit greater explanatory power [42].

Third, the dependent variables used in previous studies were very different, although they were all related to innovation use. There is no consistent approach to measuring innovation use. From Table 1, it would appear that the existing definitions of innovation use can be roughly categorized into two groups. The first approach is based on Kwon and Zmud's six-phase view of the IT use process, which incorporates initiation, adoption, adaptation, acceptance, routinization, and infusion [43] (*see Figure 2*). Usually, the dependent variable—innovation use—is coded from 1 to 6 according to the six phases. This sequential-stage model of innovation use was applied by the first three empirical studies listed in Table 1. The second approach is based on Massetti and Zmud's four facets of EDI use measurement: volume, diversity, breadth, and depth [50] (*see Table 2*). This dimensional-measurement approach was adopted by five studies in Table 1 (#5, 6, 7, 8, 9). Tornatzky and Klein's meta-analysis and Massetti and Zmud's study both point out that inconsistent definitions of IT adoption and use lead to inconsistent findings [50, 73]. The right-hand column in Table 1 shows that the earlier studies produced disparate results regarding the determinants of innovation use.

While the studies in the table all significantly expanded the understanding of innovation use, the issues identified above show that the literature lacks a unifying framework [1]. A review study by Fichman suggests that future research in the innovation diffusion area should try to combine multiple theoretical streams into a more integrated view of IT innovation [16]. In this vein, proposing and testing an integrated model to identify the determinants of e-business use is the objective of this paper. The integrated model presented here is not exhaustive, but it is an important step in that direction.

Research Framework and Hypotheses

Based on the literature, a framework was developed that combines factors identified in theoretical and empirical research as important determinants of the use of IS innovations, and therefore perhaps of e-business use. The framework incorporates four constructs: perceived benefits, organization readiness, external pressure, and environment. Eight independent variables are categorized into the four constructs, and two dependent variables are tested in the research model (*see Figure 3*).

Aspect	M & Z's EDI use measurements	e-business use measurements in this paper
Volume	Percentage of organization's documents exchanged via EDI	Mean percentage of on-line sales, on-line purchase, and on-line service to total sales, purchase, and service.
Diversity	Number of document types via EDI	Number of different business activities handled through Internet

Table 2. Massetti and Zmud's EDI Use Measurements [50] vs. E-business Use Measurements in This Paper.

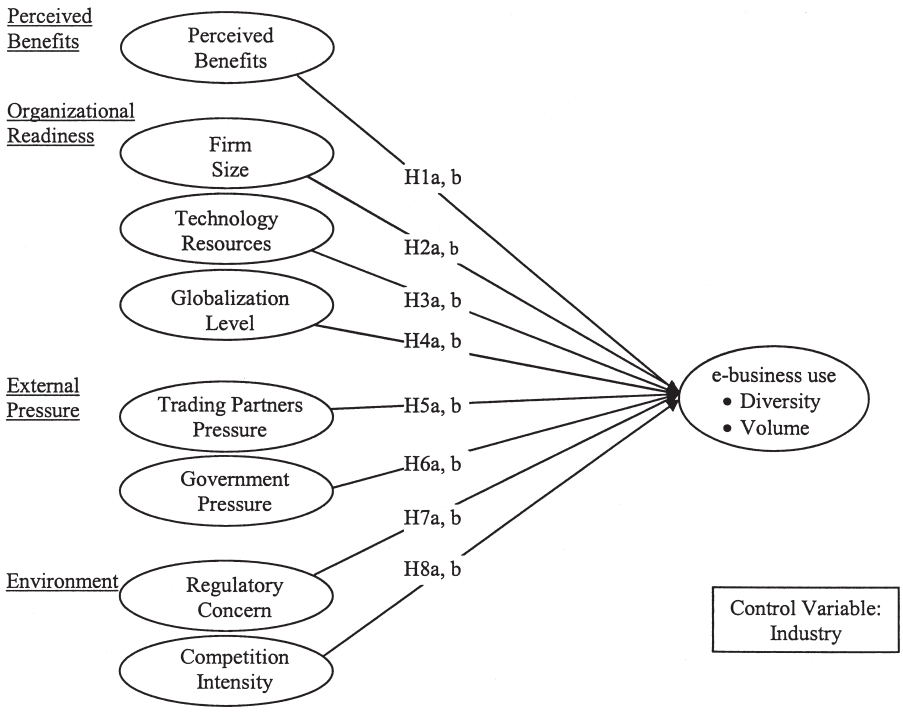


Figure 3. Research Model

Perceived Benefits Construct

Perceived benefits refers to the anticipated advantages that e-business can provide the organization. The Rogers and Iacovou models both indicate that better managerial understanding of the relative advantage of an innovation increases the likelihood of the allocation of the managerial, financial, and technological resources necessary to use that innovation [31, 65]. Previous studies argue that firms using e-business may obtain such benefits as sales increase, new market penetration, and cost reduction [45, 77, 78]. In Table 1, the empiri-

cal studies (2, 7, 9) also validate that positive perception of the benefits of an innovation provides an incentive for use of an innovation [22, 55, 69]. Therefore, the following hypotheses are generated:

H1a: Firms with higher perceived benefits of doing e-business will lead to greater diversity of e-business use.

H1b: Firms with higher perceived benefits of doing e-business will lead to greater volume of e-business use.

Organization Readiness Construct

Organizational readiness refers to the level of financial resources, technological resources, and globalization of a firm [31]. This construct measures whether firms have sufficient resources to support e-business use. If a firm lacks the resources necessary for IT investment, its ability to fully use the innovation is limited. While financial and technological resources are the two most commonly studied independent variables in the innovation use literature, globalization level is developed and included in the present study because it is critical for the e-business phenomenon [45].

Firm Size

The relative importance of size as a predictor of organizational innovativeness and the direction and nature of the causal influence of size on innovativeness is a persistent controversy in the IS and organizational research literature [15]. Most IS researchers treat firm size as a proxy variable for financial resources—in other words, the ability of a firm to pay for installation costs, integration costs, employee training costs, and maintenance costs. Larger firms usually have the available financial resources to be better equipped and implement innovations [31, 65]. However, some researchers in organizational and strategic areas argue that large firms are more bureaucratic and less flexible, are unable to change and adapt quickly, and have higher structural inertia [29, 74]. Therefore, large size has also been said to inhibit innovation.

Nonetheless, firm size has consistently been found to be positively related to IS innovation use in empirical research. In Table 1, the studies by Fichman and Kemerer and by McGowan and Madey report a positive relationship between firm size and innovation use [18, 51]. Most empirical studies of IS innovation adoption and firm size also indicate that there is a positive relationship between the two variables [21, 56, 71, 79]. Since e-business is an IS innovation, one would expect resource advantages to be more significant than structural inertia, and size to affect e-business use positively.

H2a: Large firms will have greater diversity of e-business use.

H2b: Large firms will have greater volume of e-business use.

Technological Resources

The technology resources factor is concerned with the level of sophistication of IT usage in an organization. Firms with more required technology resources (hardware, software, expertise) may have greater ability to use e-business [31]. Kowtha and Choon indicate that new technology use is significantly contingent on complementary resources and existing technologies since firms that are already familiar with IT seem to show a positive attitude toward further IT extension [37]. In an empirical study, Zhu, Kraemer, and Xu found a significant relationship between technological resources and organizational innovativeness [79]. Thus,

H3a: A firm with more technology resources will have greater diversity of e-business use.

H3b: A firm with more technology resources will have a greater volume of e-business use.

Globalization Level

Level of globalization has an influence on a firm's use of e-business because the Internet can be used to gain global visibility across an extended network of trading partners and respond quickly to a range of business conditions, from changes in customer demand to resource shortages [45]. Globalization challenges firms to be more streamlined and efficient. E-business can fulfill these requirements and simultaneously expand firms' geographic reach. Globalization level is a new factor closely related to the characteristics of e-business, but it has rarely been empirically examined in the literature. The study by Xu, Zhu, and Gibbs shows that globalization is a driver of Internet adoption [75]. Therefore,

H4a: A more global firm will have greater diversity of e-business use.

H4b: A more global firm will have a greater volume of e-business use.

External Pressure Construct

External pressure refers to two main sources of pressure that influence firms to use e-business: trading partner pressure and government pressure.[2]

Trading Partner Pressure

Network effect theory holds that the value of participating in a network (or an IOS) increases for each participant as the number of participants increases. Riggins, Kriebel, and Mukhopadhyay developed a model of network exter-

nalities for the case where a buyer initiates an IOS with its suppliers [64]. They found that to achieve maximum benefits, buyers should press or even subsidize their suppliers to join the IOS. Iacovou, Benbasat, and Dexter also argue that a powerful supplier or customer may pursue strategies to induce its partners to use e-business because the greatest value can be achieved only when many members of the supply chain are using it [31]. Referring back to the empirical studies in Table 1, Hart and Saunders found a significant relationship between trading partner pressure and EDI use [27]. The empirical work of Chwelos, Benbasat, and Dexter confirms this relationship [8]. Since e-business is the successor of EDI, one may hypothesize:

H5a: A firm facing greater trading partner pressure will have greater diversity of e-business use.

H5b: A firm facing greater trading partner pressure will have a greater volume of e-business use.

Government Pressure

The role of institutions such as governments is an essential component of IT use [36]. Governments may establish requirements for firms doing business with the government or provide incentives to adopt technology or practices, or both [54]. Empirical studies of the remarkable progress of Japan, Korea, Singapore, and other Pacific Rim countries cite government as a major factor in their success [40]. Therefore, the following hypotheses are proposed:

H6a: A firm facing greater government pressure will have greater diversity of e-business use.

H6b: A firm facing greater government pressure will have a greater volume of e-business use.

Environment Construct

The environment is the arena in which a firm conducts its business. It can influence the degree to which a firm sees the need for, seeks out, and brings in new technology. Based on Tornatzky and Fleischer's definition, the environment construct consists of regulatory concern and competition intensity [72].

Regulatory Concern

Haywood's study showed that regulation may discourage the use of innovation [28]. He found that banks located in states that restrict branch-office banking were less likely to offer computer-based services to their customers. Hof argued that in past technology revolutions, regulation often lagged both

technology and organizational change [30]. In the Internet age, Internet sales tax is an underlying problem behind e-business use. Under the Internet Tax Moratorium Act in the United States, sales over the Internet are taxed by state and local governments. If a business has a physical presence in the state where a purchase is made, it must impose that state's sales tax on the purchase. Thus, in order to be in full compliance with the law, an e-business merchant has to track the rules and regulations of every state and locality in which its customers reside [48]. Internet sellers are now calling for a fundamental restructuring of the Internet sales tax system to reduce compliance costs on retailers and consumers. Another concern regarding e-business law is the Electronic Signatures in Global and National Commerce Act (E-SIGN). Although E-SIGN ensures the legal validity of electronic signatures and contracts, the law provides little legal protection against fraudulent use of e-signatures [19]. Consequently,

H7a: A firm facing higher regulatory concern will have lower diversity of e-business use.

H7b: A firm facing higher regulatory concern will have lower volume of e-business use.

Competition Intensity

Economists have hypothesized that the spread of an innovation will either increase or decrease with competition intensity. The Schumpeterian hypothesis indicates that monopoly power is conducive to technical advance [66, 67, 68]. The alleged reason is that innovation is both a means for realizing monopoly profits and a method of maintaining them afterward. Thus, firms possessing monopoly power should be more inclined to innovate because they are better able to realize the rewards from innovation than firms that do not. The other side of the picture, however, is that a firm already in possession of monopoly power feels less threatened by rivals and therefore less compelled to innovate. The relative strengths of these two offsetting forces may be difficult to discern [33].

Empirical studies also show mixed results. The studies by Globerman, by Levin, Levin, and Meisel, and by Kimberly and Evanisko all indicate that more intense competition is associated with higher IT use [20, 35, 46], whereas Hannan and McDowell report that firms operating in a less competitive market are more likely to use IT [26]. In Table 1, Rai and Bajwa's analysis found that greater environmental uncertainty (competition intensity) is associated with a higher level of EIS use [60]. Since more IS research reports a positive relationship between competition and innovation use, the following hypotheses are generated and the data are used to test them:

H8a: A firm facing greater competition intensity will have greater diversity of e-business use.

H8b: A firm facing greater competition intensity will have a greater volume of e-business use.

Interaction Effect

Motivated by the theoretical argument in the globalization literature that "as firms become more global, the influence of government pressure on a firm's decision making diminishes" [13, 49], the present study examines whether there is an interaction effect between globalization level and government pressure on a firm's e-business use. Researchers in globalization studies have concluded that government intervention can substantially modify the set of strategic options available to global firms, but that international rather than local conditions weigh more heavily on global firms' investment decisions [13]. Government officials feel that the response of global firms to their policies is difficult to predict, or even understand, because a global firm's affiliates are but a part of an intensely coordinated globally optimized system [13, 49]. Thus,

> *H9: Both globalization level and government pressure have positive effects on a firm's e-business use level, but the firm's globalization level moderates the contribution of government pressure to its e-business use level. The more global a firm is, the less its e-business use level is affected by government pressure.*

Research Method

Data

The research model was tested with a questionnaire designed to collect data on the variables. Each item on the questionnaire was reviewed for content validity by an expert panel comprised of faculty whose work focuses on e-business at the University of California, Irvine, practitioners from industry, and staff from the Research Division of International Data Corporation (IDC). The initial questionnaires were pilot tested on 20 firms randomly selected from the sample frame, and some items were revised for clarity. The finalized questionnaire was provided to MarketProbe, a professional survey firm that specializes in large-scale survey research through IDC, which used it in a telephone survey conducted from February to April 2002.

Transparency in data collection was induced by stipulating a number of conditions on the survey agency. Firms were selected from Dun & Bradstreet, a list source representative of the entire U.S. market. The establishment (physical location or site) was the sampling unit and the unit of the database. The sampling was a stratified random sample; stratified by size (large—250 or more employees, and small—between 25 and 249 employees) and by industry (manufacturing, wholesale/retail distribution, banking and insurance), with sites selected randomly within each industry/size cell. Interviews were conducted only with companies that use the Internet in conducting their business. Eligible respondents for the survey were the individuals considered to be the most knowledgeable about e-business use in their companies. For large

Number of employees	Percent	Industry	Percent	Respondents	Percent
< 100	37.4	Manufacturing	34.0	CEO, owner	4.3
100-249	14.6	Distribution	33.7	CIO	16.3
250-499	27.9	Finance	32.3	IS manager	53.6
> 500	20.1			Other manager	25.7

Table 3. Sample Characteristics (*N* = 294).

Note: Other managers include CFO (finance), COO (operation), and marketing managers.

sites, the respondent was a CIO or IS manager. For small sites, it was an owner or IS manager.

Several measures were taken to ensure survey quality. First, the authors attended interviewer-training sessions to make sure that interviewers understood the whole survey process. Second, some of the interviews (randomly selected) were directly monitored while in process. Third, interviewers used a computer-assisted telephone interviewing (CATI) system to make sure that they did not skip questions or rotate question numbers. Fourth, interviewers used validation screens programmed into the CATI system to verify publicly available information about revenue, employee number, and industry type.

The target completes were 300 interviews, equally divided by size (small/large) and industry category. In total, 3,987 potential respondents were contacted by telephone. The response rate was around 8 percent.[3] The raw data received from the survey agency were checked for consistency, and six outliers were excluded based on sales and employee number. This resulted in the final sample of 294 observations. Tables 3 and 4 shows the sample characteristics and descriptive statistics.

Since all of the data were self-reported, two approaches were used to ascertain whether these surrogate measures provided true assessments of the variables. First, the survey responses were compared to industry norms or third-party resources, where available. For example, the employee numbers reported in the survey were compared to the employee figures obtained from the Hoovers.com database. The correlation between the two measures was 0.948. According to our data, firms purchased 15 percent of production goods and 18 percent of maintenance, repair, and operating (MRO) goods on-line, as compared to a study reporting corresponding percentages of 17 percent and 19 percent [3]. The study data also showed that 44 percent of U.S. firms sell on-line and 77 percent of U.S. firms purchase on-line, whereas a 2002 Dun & Bradstreet/Forrester research report stated that the corresponding figures were 30 percent and 82 percent, respectively [14].

Second, for other self-reported variables that were difficult to check directly because of their inaccessibility to external observers, an effort was made to determine whether there was a survey bias among the respondents in the data set. One might suspect that IS people have a positive bias when rating drivers of e-business use, such as e-business benefits, but overlook the influence of e-business barriers, such as regulatory concerns. Therefore, the Mann-Whitney U-test was used to compare the means for the IS managers group

Variable	*M*	*SD*
Diversity of e-business use	4.04	1.81
Volume of e-business use:		
% of B2C on-line selling	4.91	14.00
% of B2B on-line selling	5.42	15.88
% of on-line procurement	17.89	26.11
% of B2C on-line services	15.33	7.34
% of B2B on-line services	9.39	18.17
Firm size	605	2,665
Technology resources	3.00	1.75
Globalization level:		
Establishment outside U.S.	34%	NA
Headquarters outside U.S.	7%	NA
% of total sales from outside U.S.	6.60	12.50
% of total procurement from outside U.S.	7.88	17.09

Table 4. Descriptive Statistics.

(CIO and IS managers) and the non–IS managers group (CEO, owners, business operations managers, finance managers, and marketing managers) in the survey data. The Kolmogorov-Smirnov test was used to test the null hypothesis that the sample distributions of the two groups were equal. The results are shown in Table 5. The p-value associated with each test statistic on each item was insignificant ($p \geq 0.1$), with only one exception: Non–IS managers showed more concern about taxation of Internet sales than IS managers. In general, the responses from the two groups did not differ significantly.

Operationalization of Constructs

The constructs and measurement items used in this research were adapted from previously validated measures or were developed on the basis of a literature review. The operationalization of constructs and prior research support are discussed below and listed in Appendix A.

Perceived Benefits Construct

The construct of perceived benefits was measured by three items that reflect the potential benefits of using e-business to expand current market, enter new businesses, and catch up with major competitors. The three items were selected based on previous studies. Zhu's research on e-business impacts indicates that firms using e-business can obtain such benefits as sales increase [77]. Lee and Whang's paper on e-business suggests that Internet technology helps firms penetrate new markets [45]. Chwelos, Benbasat, and Dexter's study on EDI validates that electronic network technology enhances firms' ability to compete [8]. The way the present study measured the perceived benefits construct is similar to the method used in the studies by Premkumar, Ramamurthy,

Items measuring e-business determinants (five-point Likert scale)	IS managers		Non-IS managers		Mann-Whitney test		Kolmogorov-Smirnov test	
	M	*SD*	*Mean*	*SD*	*z*	*p*	*z*	*p*
To expand market for existing product/services	3.49	1.39	3.55	1.45	-0.497	0.619	0.372	0.999
To enter new businesses or markets	3.08	1.45	2.98	1.52	-0.501	0.617	0.383	0.999
To catch up with major competitors that are on-line	3.29	1.41	3.13	1.41	-0.941	0.347	0.522	0.948
Customers demand e-business	3.16	1.37	2.87	1.35	-1.649	0.100	0.704	0.705
To improve coordination with suppliers and customers	3.38	1.3	3.29	1.43	-0.255	0.799	0.514	0.954
Suppliers require it	2.07	1.35	2.16	1.32	-0.765	0.444	0.425	0.994
Required for government procurement	1.48	0.99	1.62	1.05	-1.331	0.183	0.591	0.876
Government provided incentives	1.31	0.80	1.35	0.78	-1.181	0.238	0.535	0.937
Inadequate legal protection for Internet purchases	1.90	1.05	2.15	1.22	-1.488	0.137	0.870	0.435
Business laws do not support e-commerce	1.85	1.01	2.01	0.99	-1.517	0.129	0.700	0.712
Taxation of Internet sales	1.55	0.98	1.99	1.16	-3.314	0.001	1.514	0.020

Table 5. IS Managers vs. Non–IS Managers.

and Nilakanta and by Grover and Teng in Table 1 [22, 55]. Respondents were asked to rate how important each of the three items was to their organization's decision to begin using the Internet for business. A five-point Likert scale was used, with 1 representing not at all and 5 reflecting a great deal.

Organization Readiness Construct

The technology resources factor was measured by summing six binary questions (Yes = 1, No = 0) asking whether each of six e-business-related technologies (Web site, extranet, intranet, etc.) was used in the respondent's organization. The theoretical rationale is that Crook and Kumar define technological resources as an aggregate term to describe state-of-the-art technology and its use for productive business processes [10]. According to Zhu and Kraemer, e-business infrastructure is built on Internet-related technologies, such as intranet, extranet, EDI, and Web sites [78]. Kowtha and Choon validate a similar measure of technological resource that includes Web site use, intranet use, and extranet use, among others [37]. Evaluating the role of aggregation in the measurement of IT-related organizational innovation, Fichman justifies that aggregated measures are more robust and can promote stronger predictive validity under some circumstances: (1) when the research objective is to identify determinants of organizational innovativeness and (2) when the innovations being aggregated are related, substitutable, or moderately complementary [17]. Since the technology resources measure proposed in this paper satisfies these two circumstances, the aggregated procedure should be favorable.

Globalization level is a new factor that has rarely been tested in the innovation use literature, but is closely related to the characteristics of e-business. Porter indicates that firms compete with truly global strategies involving selling, sourcing materials worldwide, and locating activities in many nations to take advantage of low cost factors [54]. Drawing upon Porter's definition of globalization, as well as a previously validated measure in Xu, Zhu, and Gibbs's study [75], globalization level is operationalized by four indicators measuring a firm's global scope (e.g., having establishments outside the United States, having headquarters outside the United States, percentage of total sales from outside the United States, and percentage of total purchase from outside the United States).

External Pressure Construct

Trading partner pressure was measured by three items: customers demand e-business, suppliers require e-business, and improved coordination with suppliers and customers. Powerful suppliers and customers may require, threaten, or reward business partners for using e-business. Only when many members of the supply chain are using it can the greatest value be achieved [31]. The three items are adapted from the studies by Hart and Saunders and by Chwelos, Benbasat, and Dexter [8, 27].

Government pressure was operationalized by two items: required for government procurement and government provides incentives. Previous studies on government and innovation diffusion suggest that government plays an important role by either requiring or inducing firms to use new technology [39, 65]. Research on e-business diffusion by Kramer, Gibbs, and Dedrick shows that government promotion of e-business use takes various forms, such as providing technical support, training, and funding [39]. Porter argues that government, as a major buyer of many products in a nation, can create opportunities and pressures for continued innovation [54].

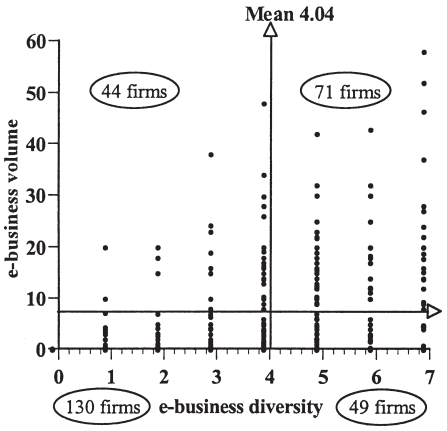
Environment Construct

Regulatory concern was measured by three items: legal protection of Internet purchases, support of business laws, and taxation of Internet sales. Based on previous studies examining the relationship between regulation and innovation [19, 28, 30, 48], the three indicators were adapted to adhere more closely to U.S. e-business policies and regulation. A similar measure including both legal and tax indicators was used and validated by Ranganathan et al. in their research on B2B e-commerce applications [62].

Competition intensity was measured by the degree of rivalry among existing competitors in a firm's local area, country, or worldwide, whichever was highest. The three items were developed based on Porter's national diamond framework, in which competition may come from three sources: local competitors, domestic rivals, and foreign contestants [54]. Since firms operate in different geographic scopes, the three indicators do not necessarily correlate with one another. Therefore, they were not combined as a latent variable but instead the highest value among the three questions was chosen. Zahra's study used a similar measure to gauge competitive rivalry [76].

Dependent Variables

Two dependent variables were used in the framework: diversity of e-business use and volume of e-business use. Diversity of e-business use was an aggregate measure of the extent to which different aspects of a firm's business activity are handled through the Internet. The construct was measured by asking respondents to indicate whether each of the seven possible e-business activities (sell on-line, purchase on-line, exchange data on-line, joint business processes with partners on-line, etc.) was used in their organization (Yes = 1, No = 0). The theoretical rationale was Zwass's identification of the principal aspects of e-business in five broad domains: commerce, collaboration, communication, connection, and computation [81]. The summative measure follows Massetti and Zmud's definition of diversity and was used to gauge the diversity of EDI use in empirical studies [27, 50, 51, 69]. Volume of e-business use was measured by the mean percentage among all business activities conducted on-line in a company. Respondents reported the volume for each type of transaction by indicating what percentage of that type of transaction was performed on-line. The



Count		e-business diversity		Total
		Low	High	
e-business volume	High	*44*	*71*	*115*
	Low	*130*	*49*	*179*
Total		*174*	*120*	*294*

*Low: below the mean, High: above the mean

Figure 4. Diversity and Volume of E-Business Use (scatterplot of our data)

way the two variables were measured was based on Massetti and Zmud's definition of IT use and is consistent with prior research [27, 50, 51, 69].

As can be seen from the data in Figure 4, high diversity of e-business use was not equal to high volume of e-business use, which confirms Massetti and Zmud's argument that there are different facets of IT use [50]. For example, the 49 firms located in the lower-right part of the figure reported high diversity of e-business use, but a lower than average volume of e-business use. Likewise, the 44 firms located in the left-upper part of the figure had high volume but low diversity. These two groups of firms represented around one-third of the total sample.

Data Analysis and Results

Evaluating the Measurement Model

The measurement model investigated in this study consisted of five multi-item constructs: perceived benefits, globalization level, trading partner pressure, government pressure, and regulatory concern. Sixteen indicators were grouped into the five corresponding latent variables, in accordance with the literature. Confirmatory factor analysis (CFA) using AMOS 4.0 structural equation modeling software was conducted to check the reliability and validity of the measurement model. The results and statistical measures are provided below.

Convergent validity was verified through the *t*-statistic for each factor loading. Most of the factor loadings in the initial model comprising 16 indicators were significant, with the exception of one item (PB4; see Appendix A). After

this item was eliminated, all the factor loadings were greater than the typical cutoff value of 0.5 and significant at the $p < 0.01$ level, as shown in Table 6, evidencing good convergent validity [25]. Discriminant validity measures the extent to which different constructs diverge from one another. The diagonal elements in Table 7, representing the square root of average variance extracted (AVE), are a measure of the variance between a construct and its indicators. The rule of thumb for assessing discriminant validity requires that the square root of AVE be larger than the correlations between constructs, that is, the off-diagonal elements [9, 25]. Tables 7 and 8 provide strong evidence of discriminant validity.[4]

Reliability measures the stability of the scale based on an assessment of the internal consistency of the items measuring the construct. It is assessed by calculating the composite reliability for each composite independent variable. In the measurement model shown in Table 6, most of the constructs have a composite reliability over the cutoff of 0.70, as suggested by Straub [70], while two constructs have a reliability close to this cutoff (0.659 for trading partner pressure, and 0.689 for regulatory concern).

Goodness-of-fit measures the correspondence of the actual input covariance matrix from the data with that predicted from the proposed research model. There are three types of goodness-of-fit measures: (1) absolute fit measures, (2) incremental fit measures, and (3) parsimonious fit measures [25].

1. Absolute fit measures determine the degree to which the overall model (the theoretical model) predicts the observed covariance matrix (data). The root mean square error of approximation (RMSEA) is the measure best suited for use in a confirmatory model with larger samples [63]. RMSEA is the discrepancy per degree of freedom, and values ranging from 0.05 to 0.08 are deemed acceptable [25]. The measurement model tested in the present research has an RMSEA value equal to 0.063, as can be seen in the right-hand column of Table 6, which satisfies the recommended criteria.
2. Incremental fit measures compare the proposed model to a baseline model. The Tucker-Lewis index (TLI), the normed fit index (NFI), the incremental fit index (IFI), and the comparative fit index (CFI) are all commonly used incremental fit measures. The recommended acceptance level for these indices is a value greater than 0.90 [25]. As shown in Figure 5, the indices fulfill the requirements.
3. Parsimonious fit measures the goodness-of-fit of the model to the number of estimated coefficients required to achieve this level of fit. The objective is similar to the adjustment of R^2 in multiple regression. Normed chi-square (chi-square/degrees of freedom) is a frequently used parsimonious measure proposed by Joreskog [32]. A value less than 3 implies a good model fit and no evidence of overfitting [6]. The tested measurement model in the present research satisfies the recommended criteria.

In conclusion, all the above indices indicate that the model fit the data very well.

Construct	Indicators	Factor loadings	Composite reliability	Goodness-of-fit indices
Perceived benefits	PB1	0.841***	0.765	χ^2/df = 2.180 (< 3)
	PB2	0.753***		TLI = 0.976 (> 0.9)
	PB3	0.555[a]		NFI = 0.972 (> 0.9)
				CFI = 0.984 (> 0.9)
				IFI = 0.984 (> 0.9)
				RMSEA = 0.063 (< 0.08)
Globalization level	GL1	0.693***	0.700	
	GL2	0.654***		
	GL3	0.544***		
	GL4	0.513[a]		
Trading partner pressure	TP1	0.706***	0.659	
	TP2	0.657[a]		
	TP3	0.508***		
Government pressure	GP1	0.774***	0.729	
	GP2	0.742[a]		
Regulatory concern	RC1	0.757***	0.689	
	RC2	0.599[a]		
	RC3	0.595***		

Table 6. Measurement Model: Loadings, Reliability, and Convergent Validity.

Notes: [a] loadings are specified as fixed to make the model identified; ***$p < 0.01$.

Constructs	PB	GL	TP	RC	GP
Perceived benefits	0.726				
Globalization level	0.216	0.606			
Trading partner pressure	0.589	0.235	0.629		
Regulatory concern	0.169	0.183	0.250	0.655	
Government pressure	0.332	0.136	0.478	0.32	0.758

Table 7. Discriminant Validity of Instruments.

Notes: Diagonal elements are the square root of average variance extracted (AVE), which, for discriminant validity, should be larger than interconstruct correlations (off-diagonal elements).

Constructs	Constrained model χ^2 (df)	Unconstrained model χ^2 (df)	$\Delta\chi^2$
Perceived benefits			
Globalization level	201.537 (16)	37.404 (15)	164.133***
Trading partner pressure	121.701 (11)	59.76 (10)	61.941***
Regulatory concern	167.231 (11)	9.029 (10)	158.202***
Government pressure	155.627 (7)	9.610 (6)	146.017***
Globalization level			
Trading partner pressure	144.381 (16)	24.349 (15)	120.032***
Regulatory concern	152.001 (16)	15.784 (15)	136.217***
Government pressure	184.008 (11)	18.149 (10)	165.859***
Trading partner pressure			
Regulatory concern	130.345 (11)	12.908 (10)	117.437***
Government pressure	82.968 (7)	17.903 (6)	65.065***
Regulatory concern			
Government pressure	119.614 (7)	3.526 (6)	116.088***

Table 8. Assessment of Discriminant Validity.

All differences in χ^2 are significant at $p < 0.01$.

Testing the Structural Model

The empirical results of the structural model, as calculated by AMOS 4.0, are presented in Figure 5. The path coefficients using normal fonts in the left column represent the diversity of e-business use, while the underlined path coefficients in the right column represent the volume of e-business use. Both of the models were run using standardized construct values, so the standardized path coefficients can be interpreted and compared directly. The goodness-of-fit indices (chi-square/df, TLI, NFI, CFI, IFI, RMSEA) satisfy the recommended criteria.

Hypotheses Testing

Diversity of e-business use (H1a, H2a . . . H8a). Six of the eight tested variables showed significance. Perceived benefit (H1a), technology resources (H2a),

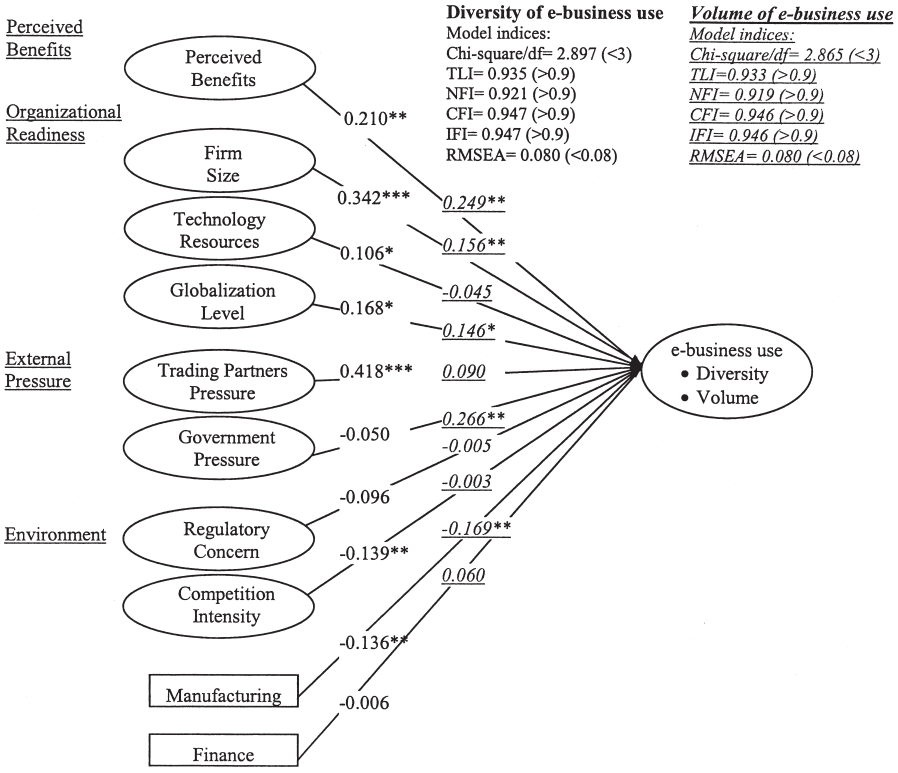


Figure 5. Empirical Results (structural model)
Notes: *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$.

firm size (H3a), globalization level (H4a), trading partner pressure (H5a), and competition intensity (H8a) were found to be significant factors influencing the diversity of e-business use. Testing all the factors together in one model made it possible to investigate the relative contribution of each factor to e-business use. Among the six factors, trading partner pressure was found to be the most important factor influencing the diversity of a firm's e-business use. Since e-business is related to several firms or parties, supplier and customer pressure play a critical role in pushing or pulling firms to engage in more e-business use. More and more companies are apparently realizing that if they want to fully obtain the benefits of e-business, they have to send a clear message to their business partners. For example, IBM executives have said to their trading partners: "If you want to do business with us, do it electronically" [4].

More interesting, unlike what the previous studies concluded and the hypothesis predicted, government pressure (H6a) is not a significant factor leading U.S. firms to engage in greater diversity of e-business use. As indicated above, trading partner pressure is generally more important than government pressure. It is also likely that the role of government in promoting the diversity of e-business use is not as important in the United States as in developing countries or small countries. Kuan and Chau's research showed a positive

relationship between government pressure and innovation use, but this may be so because they only investigated companies in Singapore [41]. Singapore has a highly centralized institutional authority that strongly influences firms' technology decisions, whereas the U.S. government policy on e-business lets the private sector take the lead, with government helping to provide the right business climate for innovation [19, 24].

Regulatory concern (H7a) is not a significant inhibitor of U.S. companies with respect to the diversity of e-business use. The insignificant path coefficient (–0.096) shows that the United States may have a better regulatory environment supporting e-business use and U.S. companies express less regulatory concern when doing e-business.

Contrary to the hypothesis, competition intensity (H8a) was a significant inhibitor of diversity of e-business use. Firms in a more competitive industry may have less diversity of e-business use. One possible explanation is that firms facing excessive competition do not have adequate slack resources to try innovations. This result supports Schumpeter's hypotheses that in a modern industrial economy, innovation is greater in monopolistic industries than in competitive ones because a firm with monopoly power can prevent imitation and thereby can capture more profit from an innovation [66, 67, 68]. Mendelson's case studies of unsuccessful on-line grocery stores indicate that with grocery margins as thin as 2 percent and packaging and delivery as much as $40 per order, it is hard for this industry to make money on-line [53].

Finally, dummy variables were used to test the differences between the three industries. The manufacturing dummy variable had a significant negative coefficient, which means that the manufacturing sector is lagging in diversity of e-business use. Firms in distribution (wholesale and retail) and financial industries that face end-consumers directly are more likely to lead in using e-business for more activities. A possible reason is that retail and financial firms focus more on front-end applications (on-line selling, on-line advertising), whereas manufacturing firms focus more on back-end e-business applications (e-supply chain management). Back-end e-business applications are more complex and costly to implement than setting up a Web site to do on-line selling with end-consumers.

Volume of e-business use (H1b, H2b . . . H8b). Four of the eight hypotheses tested in the model were supported. Perceived benefits (H1b), technology resources (H2b), globalization level (H4b), and government pressure (H6b) are significant factors affecting the volume of e-business use. Among these significant factors motivating a firm to use greater volume of e-business, government pressure is considerably the most important. This is an interesting finding that is worthy of deeper analysis.

In the summer of 2001, President George W. Bush announced that as of the end of 2002, all government agencies would use a single e-procurement portal, www.FedBizOpps.gov, to provide private-sector bidders with access to notices of solicitations of more than $25,000. FedBizOpps.gov is now the single government point-of-entry (GPE) for federal procurement opportunities. From requirements definition through contract completion, firms that want to do business with the U.S. government have to use e-business technology. A check

of the study data and of company profiles from hoovers.com found that many of the most intensive e-business users that expressed greater government pressure do business with the U.S. government. Some of these companies indicated that the U.S. government accounted for 75 percent or more of their business (hoovers.com). It is reasonable that these companies report a high volume of e-business use related to selling to the government. Thus, whereas the U.S. government has no impact on the diversity of e-business use among the majority of private companies, it has a significant influence in promoting the volume of e-business use with firms doing business with government.

Interestingly, firm size (H3b) is not a significant predictor of volume of e-business use. Three possible explanations may elucidate this result. First, the structural inertia effect may be more important in considering the volume of e-business use. Large firms have more resources to implement diversified e-business activities, but once a firm crosses the resources threshold and starts doing business on-line, size may not influence how intensively it does business on-line. Second, since the study's volume measure included on-line selling, on-line purchasing, and on-line service percentages, the greater-volume e-business users in the sample included several dot.coms that usually report 100 percent e-business use. The fact that dot.coms are comparatively smaller firms may explain part of the findings.[5] Third, previous studies found a positive relationship between firm size and innovation use because they focused on innovations that need a huge investment, such as EDI [51]. EDI is a dedicated system that requires a huge expenditure for installation, maintenance, and training before it can be fully used in an organization. Usually, only large companies have the resources to build and use these expensive innovations. In contrast, when on-line selling, purchasing, and service are being considered, e-business uses standardized Internet technology. Companies invest less money in these backbone facilities than in EDI. Zhu, Kraemer, and Xu argue that in countries with high e-business intensity, e-business is no longer a phenomenon dominated by large firms [79]. The study's finding is consistent with their result.

Trading partner pressure (H5b) also does not significantly influence the volume of e-business use. Since government is the most powerful trading partner of these high-intensity e-business users, one explanation holds that the importance of trading partner pressure may be shared by government pressure. This explanation is confirmed by the 0.716 correlation coefficient between government pressure and trading partner pressure for the high-volume e-business users in the sample, namely, the 15 most intensive e-business users (5% of the sample conducting at least 30% of e-business transaction on-line).[6]

Regulatory concern (H7b) was not an inhibitor of volume of e-business use. This again confirms that the United States has a positive regulatory environment supporting e-business. Moreover, competition intensity (H8b) was not a significant driver of volume of e-business use. Although the path coefficient (–0.003) was not significant, the negative sign is consistent with H8a, showing that a firm in a more competitive industry may use less e-business.

Finally, consistent with the result that the manufacturing sector is lagging in the diversity of e-business use, the manufacturing dummy variable shown

in the volume model also indicates that manufacturing firms do not use e-business as intensively as firms in financial and distribution industries.

Interaction effect (H9). Using Kenny and Judd's product-indicator approach of estimating interaction effect [34], a structural model containing an interaction term (globalization level * government pressure) was re-examined. Table 9 shows that the interaction effect was insignificant in the diversity model. A more important finding is that the interaction term showed a significant negative moderation effect in the volume model. Equation (1) represents the result of this moderation effect: The more global a firm is, the less its e-business use volume is affected by government pressure.[7]

$$\frac{\partial(Volume)}{\partial(Gov)} = 0.283 - 0.206(Globalization). \quad (1)$$

Conclusion

The empirical results suggest that the research model can usefully explain e-business use in U.S. firms for both the diversity and volume measures. Considering the diversity of e-business use, six of the eight variables were found to be significant, with trading partner pressure being considerably more important. The study found that larger and more global firms that derive greater perceived benefits from e-business, experience greater business partner pressure, possess richer technology resources, and face less competition intensity may use more diversified e-business technology. Considering the volume of e-business use, four of the eight variables were significant determinants, with government pressure being the most important driver. More globalized firms that derive greater benefits from e-business, are subject to greater government pressure, and possess richer technology resources tend to have a higher volume of e-business use.

The most interesting and newest finding is the different effect of trading partner pressure and government pressure on e-business use. Trading partner pressure was strongly related to diversity but not to volume, whereas government pressure was strongly related to volume but not to diversity. This suggests that the role of the U.S. government in promoting diversity of e-business use may not have much effect on most private companies, but does have a significant influence in promoting volume of e-business use in firms doing business with the government. In retrospect, this is not surprising, but this dual relationship has not been previously hypothesized or discovered. Generally, U.S. government policy toward e-business is to let the private sector take the lead, with government helping to provide the right business climate. The empirical results show that the United States has a positive regulatory environment for supporting e-business.

Based on comparison of the diversity and volume of e-business use models, there are three common factors motivating firms to use more diversified and intensive e-business: perceived benefits, technology resources, and glo-

	Diversity of e–business use	Volume of e–business use
Perceived benefits	0.350***	0.207**
Technology resources	0.407***	0.150**
Firm size	0.158**	-0.021
Globalization level	0.170**	0.353***
Trading Partners' pressure	0.357***	0.084
Government pressure	0.058	0.283***
Regulatory concern	-0.109	-0.028
Competition intensity	-0.146**	-0.003
Manufacturing	-0.189**	-0.157**
Finance	-0.036	0.048
Globalization level * Government pressure	-0.081	-0.206**
	Model indices	**Model indices**
	χ^2/df = 2.857 (< 3)	χ^2/df = 2.973 (< 3)
	TLI = 0.935 (> 9)	TLI = 0.929 (> 9)
	NFI = 0. 921 (> 9)	NFI = 0.916 (> 9)
	CFI = 0.947 (> 9)	CFI = 0.943 (> 9)
	IFI = 0.947 (> 9)	IFI = 0.943 (> 9)
	RMSEA = 0.080	RMSEA = 0.080

Table 9. Empirical Results (structure model with an interaction term).

*** $p < 0.01$; ** $p < 0.05$.

balization level. Given the consistent significance and magnitude showing in the diversity and volume models, these three factors appear to be fundamental and strong drivers for firms to use more e-business. The manufacturing sector lags in diversity and volume of e-business use, whereas firms in distribution and financial industries that deal directly with end-consumers are more likely to lead in using e-business. This may be due to the greater simplicity of setting up a Web site to do on-line selling and purchasing with end-consumers. In contrast, setting up an extranet for manufacturing suppliers and business partners involves complex and rich interorganizational links that are more difficult and costly to implement.

The study makes four specific contributions to the innovation use literature. First, it focuses on e-business. Previous studies examined EDI and other interorganizational information systems, but this is one of the first empirical studies of e-business. Second, it goes beyond adoption/nonadoption to look at the use of e-business. Moreover, following Massetti and Zmud, it distinguishes between volume of use and diversity of use [50]. The research indicates that e-business use is multidimensional not only because diversity and volume are two different concepts, but because they have somewhat different determinants. Third, going beyond the existing research, it identifies several new determinants of use that are highly related to the specific characteristics of e-business, such as globalization level, government pressure for e-business use, and e-business regulatory environment. Fourth, it develops a single framework that integrates factors from several theoretical perspectives in an effort to understand their relative influence on e-business use. The study argues

that discussions of e-business use should not be limited to expected gains from technology and organizational readiness but should also include pressures from external parties and the external business climate. The four constructs have never before been tested in one model.

Regarding implications for practice, the finding that external pressure is the major factor driving e-business use suggests that firms not doing e-business will be driven to do so in the future either by their trading partners or by their government customers. With regard to trading partners, the pressure will most likely come from business customers that require suppliers to use e-business for greater supply-chain efficiency and coordination. Similarly, firms that are suppliers to federal, state, or local government need to recognize that as use of the Internet for business-to-government transactions expands, they will increasingly be required to conduct transactions electronically.

Although some of the independent variables in the model are insignificant when applied to the U.S. data, they contribute to an understanding of the e-business environment in the United States. Demonstrating the statistical significance of all the variables was not the major goal of this paper. Instead, the study tried to organize and synthesize the literatures in innovation diffusion theory to investigate e-business use by U.S. firms. For instance, in the external pressure construct, trading partner pressure was strongly related to diversity but not to volume, whereas government pressure was strongly related to volume but not to diversity. This finding shows that external pressure is, in general, a significant factor for e-business use. Different kinds of external pressure are associated with different dimensions of e-business use. The fact that regulatory concern is not significant in the U.S. sample does not mean that this variable should be excluded from the model. The insignificant result only shows that regulatory concern is not an inhibitor of e-business for U.S. firms. It could be a very significant variable when data from other countries are examined.

The study has two limitations. First, budgetary constraints made it necessary to ask the same subjects to provide measures of both independent and dependent variables. Since the subjects may have given socially appropriate answers, future researchers are encouraged to use multiple responses in data collection to reduce the possibility of bias. Second, developing solid instruments in the e-business domain is still an ongoing procedure of development, testing, and refinement [80]. Although reliability and validity were empirically tested in the data set, new determinants related to e-business characteristics, such as government pressure, could be further refined.

Future research might proceed in several directions. The first direction is to examine whether on-line selling, on-line purchasing, and on-line coordination as elements in a firm's e-business process have different drivers and barriers. For example, the perceived benefits may differ significantly for firms that only do on-line selling and firms that only do on-line procurement. Similarly, on-line coordination (data exchange with suppliers and business partners) is a much more complicated interorganizational activity than on-line selling or purchasing. There should be some difference between these the three e-business dimensions regarding adoption decisions, use behavior, and business value to firms.

Second, the impact of e-business use has not been fully investigated. Although some studies using survey data have reported that e-business brings about improvements in costs, sales, and coordination [3, 80], these are subjective assessments that need to be confirmed by more objective secondary data. In addition, there should be more research attention to the relationship between the use and impact of e-business. The technocentric view holds that more technology is always better, but it is not clear whether more use of e-business translates into greater advantages for the organization [51]. The present research has examined some of the interaction effects, but there are many other moderating variables influencing the use and payoff of IT. Organizational compatibility, strategy alignment, and infrastructure are all suggested moderators in the IT productivity literature [52]. Future research might test the existence of these moderating variables in the relationship between e-business use and e-business impact.

NOTES

1. Research focusing on dichotomous "innovation adoption" is not the focus of this paper and is not included in Table 1. The innovation adoption literature is reviewed by Chwelos, Benbasat, and Dexter [8].

2. It is necessary to separate the two sources of pressure to see their influence individually. Theoretically, since not every firm does business with government, the importance of government pressure influencing each firm's decision on innovation use is different. Empirically, confirmative factor analysis provides statistical support for not grouping these two factors together in order to meet the requirement of unidimensionality and convergent validity.

3. The focus of this paper is on the relationships between variables and testing the research model, not on any specific population.

4. Another criterion, suggested by Gerbing and Anderson, is also used to test discriminant validity [23]. This criterion asks whether the correlations between any two constructs are significantly different from unity. It can be tested by comparing an unconstrained measurement model that freely estimates the correlation between two constructs of interests with a constrained model with that correlation fixed as unity. The chi square between these two models should be significantly different. Table 8 provides strong evidence of discriminant validity.

5. A *t*-test was conducted to compare the mean value of employee numbers between dot.coms and traditional firms. The results indicate that dot.coms had significantly fewer employees than traditional firms.

6. For the whole sample, the correlation coefficient of these two variables was 0.478 (*see Table 7*). As a result, multicollinearity was not a concern.

7. The interaction effects between firm size and trading partner pressure were also tested, as were those between perceived benefits and competition intensity, based on a reviewer's suggestion, but no significant results were found.

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Appendix A. Measurement Items for Key Research Variables

Variable	Indicators	Literature support
Perceived benefits	Using a five-point scale where 5 is "a very significant factor" and 1 is "not a factor at all," please rate how significant each of the following was to your organization's decision to begin using the Internet for business: [PB1] To expand market for existing product/services [PB2] To enter new businesses or markets [PB3] To catch up with major competitors that are on-line [PB4] To reduce costs (Drop finally)	Chwelos, Benbasat, and Dexter [8] Lee and Whang [45] Zhu [77]
Technology resources	Sum of the following questions: Does your organization have a Web site accessible by the public? (Y/N) Does your organization use an intranet (Y/N) Does your organization use an extranet (Y/N) Is this extranet accessible by supplier (Y/N) Is this extranet accessible by customer (Y/N) Does your organization use a call center (Y/N)	Crook and Cumar [10] Zhu, Kraemer, and Xu [79] Kowtha and Choon [37]
Firm Size	Number of employees, logarithm-transferred	Zhu, Kraemer, Xu, and Dedrick [80]
Globalization level	[GL1] What percentage of your organization's total sales are from outside the U.S.? [GL2] Does your organization have any establishments outside the U.S.? [GL3] What percentage of your organization's total purchase are from outside the U.S.? [GL4] Does your organization have its headquarters outside the U.S.?	Porter [54] Xu, Zhu, and Gibbs [75]
Trading partner pressure	Using a five-point scale where 5 is "a very significant factor" and 1 is "not a factor at all," please rate how significant each of the following was to your organization's decision to begin using the Internet for business: [TP1] Customers demand it [TP2] To improve coordination with suppliers and customers [TP3] Suppliers require it	Hart and Saunders [27] Chwelos, Benbasat, and Dexter [8]

(continues)

Variable	Indicators	Literature support
Government pressure	Using a five-point scale where 5 is "a very significant factor" and 1 is "not a factor at all," please rate how significant each of the following was to your organization's decision to begin using the Internet for business: [GP1] Required for government procurement [GP2] Government provided incentives	Kraemer, Gibbs, and Dedrick [39] Porter [54]
Regulatory concern	Using a five-point scale where 5 is "a very significant factor" and 1 is "not a factor at all," how much do the following affect your organization's decision to do business on-line? [RC1] Inadequate legal protection for Internet purchases [RC2] Business laws do not support e-commerce [RC3] Taxation of Internet sales	Ranganathan et al. [62]
Competition intensity	Whichever is highest in the following: Using a five-point scale where 5 is significantly affected and 1 is not al all affected, please tell me how much your organization is affected by Competitors in your local area Competitors inside your country Competitors worldwide	Porter [54] Zahra [76]
Diversity of e-business use	Sum of the following questions: Does your establishment use the Internet for . . . Advertising and marketing on-line (Y/N) Making sales on-line (Y/N) After-sales customer service and support on-line (Y/N) Making purchases on-line (Y/N) Data exchange with suppliers on-line (Y/N) Data exchange with customers on-line (Y/N) Joint business processes with suppliers or cooperation partners on-line (Y/N)	Hart and Saunders [27] McGowan and Madey [51] Massetti and Zmud [50] Son, Narasimhan, and Riggins [69]
Volume of e-business use	Average of the following numbers: Percentage of customer sales conducted on-line (B2C)? Percentage of business sales conducted on-line (B2B)? Percentage of procurement conducted on-line? Percentage of customer services conducted on-line? Percentage of business services conducted on-line?	Hart and Saunders [27] McGowan and Madey [51] Massetti and Zmud [50] Son, Narasimhan, and Riggins [69]

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